RESEARCH HIGHLIGHT

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BUILDING CANADA: PHASE ONE

BACKGROUND

For almost a decade, the Building America program has aimed to increase energy efficiency and affordability, primarily for single-family homes, in the United States. The program relies on teams with expertise in the key facets of homebuilding, including design, engineering, manufacturing and supply of materials, construction, and finance. These experts work with builders to develop and implement innovative construction processes and technologies, treating the house and its site as an integrated, interactive system of components.

The expert teams re-engineer house designs completely so that production home builders can take advantage of advanced products and achieve maximum efficiency. A major feature of the program, and a key to its success, is the reinvestment of money saved on one element (such as a reduction in the number of framing members required) toward the cost of higher quality, high-performance components (such as energy-efficient windows) elsewhere in the building. As a result, builders and consumers save money, a market is provided for new products, and the houses are better built and more comfortable to live in than conventionally constructed homes.

A Building Canada concept has been loosely modelled on the Building America program. It too takes a holistic and whole-house view, employing a systems approach, and commits team members to continuous improvement through testing, evaluation and retesting of novel construction practices. The relationship with the builder is central to the process.

This report builds on the feasibility study of a Building Canada program in two provinces, Nova Scotia and Ontario. The research project was carried out by EnerQuality, an independent company created by the Ontario Home Builders' Association and the Canadian Energy Efficiency Alliance to manage and expand the R-2000 home program in Ontario. The aim was to secure builder support and reduce overall costs by contending with two major issues for builders: construction costs and callbacks. Savings achieved during the project would fund efficiency and performance upgrades, which could lead to R-2000 certification.

While Building Canada and the R-2000 program both result in better built, energy-efficient homes, they differ in some important respects. Unlike the R-2000 program, Building Canada would achieve its goals through partnerships with the housing industry without trade name ownership encumbrances. It could occasionally mesh with the R-2000 program, but only when specific R-2000 labels were desired. Building Canada would focus on increasing energy efficiency while reducing construction time, using and wasting fewer materials, forestalling callbacks and warranty problems, and reducing overall costs. Finally, Building Canada would be marketed to production home builders so that the program could affect as many new homes as possible.

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METHODOLOGY

Building America is funded by the United States Department of Energy and housing industry partners. Adopting the program for the Canadian market required a number of significant changes, largely to compensate for the much smaller Building Canada budget. Nevertheless, product improvement and cost efficiency remain the program's primary objectives. This pilot examined a number of factors as means of reducing costs, including construction expenditures, construction time and callback costs.

The Building Canada procedure encompasses nine steps:

1. Building Canada Introductory Presentation - Builder Interest
2. Construction Review
3. Senior Management Presentation / Formation of Building Canada Builder Team
4. Service, Designers and Building Officials Workshop / Redesign Sessions
5. Drawings and Details Finalized
6. Trades and Building Canada Team Session
7. Construction and Inspection
8. Test & Evaluation of Results
9. Builder Commitment

These steps are adapted from the Building America process enumerated below, which is spelled out in detail in the research report:

1. Marketing (establishing a personal relationship with the builder, often over a period of five years): This step is considered crucial because builders are far more likely to trust the team if they work one-to-one, face-to-face.

2. Research (becoming familiar with a builder's operation): One of the main concerns of builders has been to reduce the number of callbacks, and it is crucial for all trades to track callback costs. To ascertain the source of these callbacks, program consultants spend one day working with the site superintendent and one day with the trades.

It is sometimes a challenge to get builders to track callback costs, but the results have been impressive when they do. Participating in the Building America program, for example, one builder in Chicago reduced problems associated with freezing pipes from approximately 100 annually to 1 or 2 annually. Cracking drywall was reduced from 85 percent to 35 percent, and problems with peeling exterior paint were almost eliminated.

3. ***Re-engineering*** (developing new house plans based on Building America principles): Changes to the builder's plans result in major changes to the mechanical system, framing components and techniques, and moisture control and thermal performance. The electrical, communications and water systems may also be improved.

4. ***Refinement*** (working with the builder and subtrades to review the re-engineered working drawings to determine the most effective efficient features to include).

5. ***Construction*** (building one or two demonstration homes according to the re-engineered and refined working drawings).

6. ***Commissioning*** (resolving any problems in the re-engineered homes): The team evaluates the duct distribution system, the building envelope, the interaction of the mechanical system and the envelope for compliance with standards.

7. ***Review and revision*** (Discussing the results of demonstration home testing with builders and contractors): Team members identify successful changes and revise changes that are not successful.

8. ***Commitment*** (applying Building America principles to a housing development): For the final step, builders follow the re-engineered plans in the construction of additional homes.

It should be noted that the builder and all tradespeople must re-evaluate their activities throughout the process. This leads to a redesign of plans at many stages of construction.

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FINDINGS

The Building Canada process encourages builders and subtrades to review and adjust their practices at all stages of construction. Because of the ongoing evaluation and review inherent in the process, builders found many opportunities for saving money while increasing energy efficiency. They would even use more expensive materials in one part of a house when this could reduce overall costs (such as for callbacks).

Nova Scotia

Builders were considered for the pilot only if they could deliver a significant number of R-2000 starts or provide lessons that could be easily applied to a large number of similar builders.

The two Nova Scotia builders who participated in the project (Builder A and Builder B) wanted to reduce upgrade costs to near zero so that they could build more R-2000 homes. Both wished to use the program as a testing ground for overcoming cost barriers and increasing the number of registrations of R-2000 homes in the province.

Even before the initial meetings, the project team recognized that Nova Scotia builders were having a difficult time meeting R-2000 energy targets in a cost-effective manner. Their request for Natural Resources Canada to review the climatic data used in HOT2000 simulations resulted in the revision of the weather file which had several implications for builders. First, the new data allowed for the elimination of insulated sheathing in exterior walls and a reduction of ceiling insulation from R50 to R40, for a possible savings of approximately $1000 in building materials alone. Revised data could also lead to significant savings by switching from heat pump to electric baseboards. The new weather file allows for far more flexibility in choosing envelope and mechanical equipment options. With the old weather file, the only consistent approach to meeting R-2000 standards seemed to require a heat pump or a solar DHW option, which would commonly add $3000 to $4000 in costs.

Builder A, a production builder active in much of Nova Scotia, offers standard house plans and custom designs. Even with this builder's high efficiency standards, R-2000 certification has presented administrative, technical and construction challenges for the firm. This is partly because materials, equipment and details are often chosen by local tradespeople in remote locations. On-site R-2000 inspections and air tests can also pose scheduling problems. This builder wanted to develop a standard specification for envelope and mechanical systems that would allow selected house models to meet the energy target in all geographical areas.

Following the recommendations of the Building Canada team, Builder A built a house to the R-2000 standard. The total upgrade cost—including administration costs—was $1400, and savings from recommendations amounted to $1500, for a net savings of $100 on the house.

Builder B, one of Halifax's premier custom builders, constructs between 15 and 20 executive homes a year. In aiming for the R-2000 standard, this builder often installs air-source heat pumps—generally a less expensive option than a boiler with in-floor heating, which is the next most popular option. However, while the basic cost might represent a savings, the required electrical panel upgrade required by such features as heat pumps and hot tubs adds considerably to the overall cost of construction.

There was not sufficient data to allow this builder to price all the Building Canada recommendations. However, as the process evolved, it became clear that the process was not suitable for a small builder whose practices were already well integrated and who had already identified most cost savings. This builder came to the project with very high standard specifications, and it was difficult to separate out specific items related to R-2000 from those that clients would expect of a high quality builder.

The report identifies a number of other general issues and considerations for cost-effective R-2000 houses. They include optimizing cost and performance by considering the implications of home orientation and window size; considering solar or heat pump-based domestic water heaters as a cost-effective way to meet energy budgets; and using a high-efficiency heat recovery ventilator (HRV) and offseting the additional cost by eliminating some supplemental bathroom fans.

The analysis stresses the importance of sub-slab insulation for Halifax specifically and for Nova Scotia generally.

Ontario

The two large Ontario production builders (Builder C and Builder D) in the project aimed to lower construction costs, shorten construction time and lower callback costs. They cited cost, including outlays incurred by subtrades, as the primary impediment to increased energy efficiency. The third Ontario builder (Builder E) was more concerned with how Building Canada could help refine his already streamlined construction techniques.

HOT2000 simulations indicated that houses could meet R-2000 specifications more easily with north–south rather than east–west orientation, by using low-E argon windows with insulated spacers, and by including a domestic hot water heater that meets new requirements for energy factor ratings. With other R-2000 upgrades, such as for furnace efficiency and HRV, Builder C would save $4570 and Builder D would save $4450. Other Building Canada team recommendations led to additional savings, some for administration and some—such as for framing, windows and mechanicals—that could improve performance substantially. In total, these recommendations resulted in enough savings ($5520 for Builder C and $4935 for Builder D) to pay for the entire R-2000 upgrade.

Some subtrades resisted changes in their practice, and the Building Canada team had to reassure them that this project did not aim to reduce their prices. In the end, the approach used for Builder C and Builder D was more successful than for those in Nova Scotia. Discussions were eventually engaging for the companies and appeared to foster commitment among the trades.

The third Ontario builder (Builder E) committed early to the construction of a Building Canada house, and a major part of the process comprised the construction review. The report enumerates in detail all the items from the construction review and specifies, far more than for any of the other builders, the major items that could result in time, labour or money savings.

Some typical items identified are as follows:

- using an engineered lumber system instead of dimensional lumber for the floor framing system
- reducing air leakage into the bedroom over the garage eliminating the double wall between the kitchen and the garage
- eliminating the stairway tall wall
- simplifying framing to accommodate mechanical, electrical and plumbing elements

Feedback from the trades was mixed. Many expressed surprise at the ease of installation of most components but pointed to disadvantages as well as benefits of the altered processes. The framing contractor, for example, commented that engineered joists, required greater care and more time to install than dimensional lumber but was impressed with the overall savings in time, energy and materials.

The house constructed by Builder E was much more daring in attempting to demonstrate some unconventional new construction technologies than had been anticipated by the Building Canada team. As the pilot progressed, the project manager pushed the limits of Building Canada objectives to optimize construction. Further complicating matters, Builder E underwent significant corporate restructuring during the process, with a loss of the individuals committed to the process. As such, it is not clear to what extent Builder E will embrace the initiative as a whole.

IMPLICATIONS FOR THE HOUSING INDUSTRY

Before the housing industry can expand the program, there must be a fuller understanding of the market for Building Canada and an expansion of the initiative to other parts of the country. To this end, the report outlines a number of steps:

- Develop a map of all production builders across Canada.
- Identify 30 key builders interested in participating in Building Canada.
- Establish and train regional Building Canada teams.
- Deploy the Building Canada teams.
- Benchmark the performance of houses before and after Building Canada upgrades.

CONCLUSIONS AND RECOMMENDATIONS

It is unclear whether this intiative could achieve the same level of support in the sparse Canadian market as is enjoyed by Building America. Building Canada will need to evolve regionally, providing customized solutions to Canada's production builders.

A number of builders who have completed the pilot phase have expressed interest in expanding the initiative to a larger number of homes. At best, however, profitability and financial self-sufficiency are not contemplated for three years. The effort associated with the Building Canada initiative for any builder is diffuse and long lasting. The Building Canada team needs to be involved at the earliest possible point in the product development cycle. This implies that from concept to construction and evaluation, it is not unreasonable for the initiative to take 18 months for any one builder.

Building Canada is clearly not tailored for the small builder. In fact, it would appear that the benefits of Building Canada may be largely lost on builders constructing fewer than 100 homes per year.

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Housing Research at CMHC

Under Part IX of the *National Housing Act*, the Government of Canada provides funds to CMHC to conduct research into the social, economic and technical aspects of housing and related fields, and to undertake the publishing and distribution of the results of this research.

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